

# PATENT ABSTRACTS OF JAPAN

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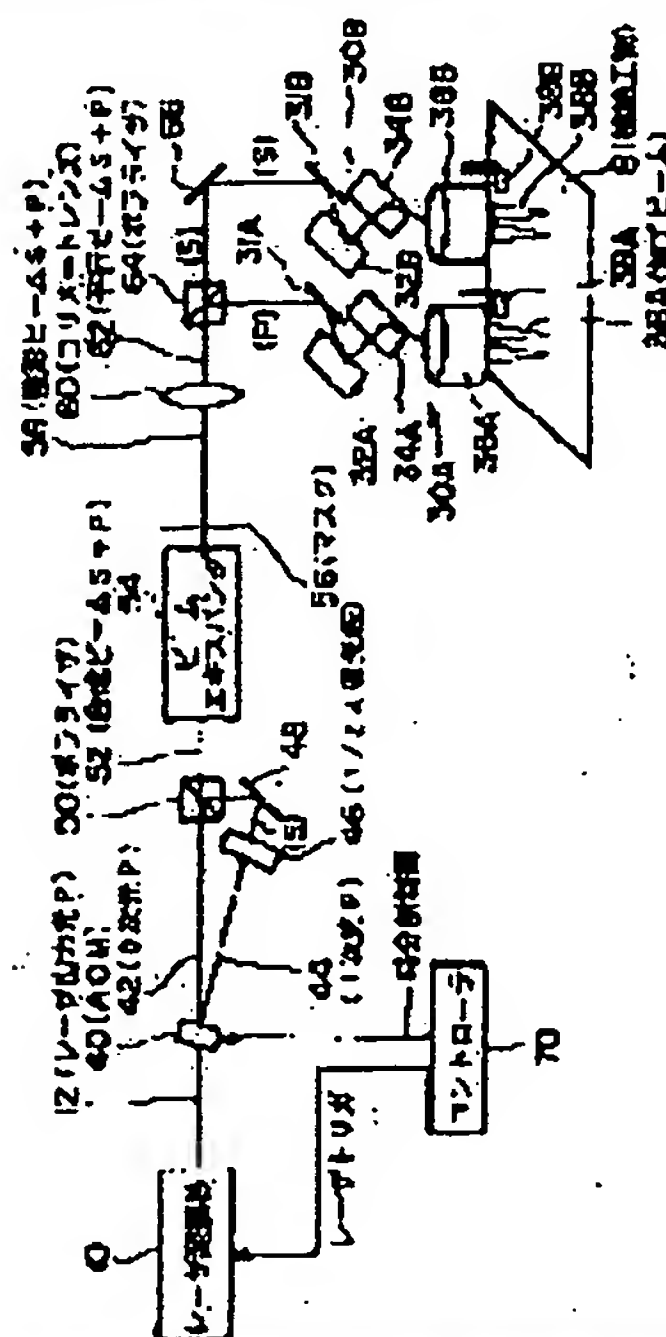
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(21)Application number : 2001-246845 (71)Applicant : SUMITOMO HEAVY IND LTD

(22)Date of filing : 16.08.2001 (72)Inventor : SUZUKI KIYOSHI

## (54) METHOD AND DEVICE FOR LASER BEAM MACHINING



(57)Abstract:

PROBLEM TO BE SOLVED: To save space by decreasing the number of elements for time division of a laser beam and sharing a part of optical parts after the time division.

SOLUTION: The deflection directions of laser beams time-divided (42 and 44) are set different from each other, returned onto the same optical axis and separated according to the deflection directions in the vicinity of machining heads 30A and 30B, and the laser beams are used for the machining.

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[Claim(s)]

[Claim 1] The laser-beam-machining approach which carries out time sharing of said laser beam, and is characterized by returning on the same optical axis, dissociating for every polarization direction near the processing head after differing mutually, and using the polarization direction of this laser beam by which time sharing was carried out for processing in the laser-beam-machining approach which supplied the laser beam outputted from one set of a laser oscillator to two or more processing heads.

[Claim 2] In the laser-beam-machining equipment which supplied the laser beam outputted from one set of a laser oscillator to two or more processing heads The polarization direction of the laser beam by which time sharing was carried out with the time-sharing means and this time-sharing means for carrying out time sharing of said laser beam by the appearance side of the polarization means for differing mutually, and this polarization means a time -- dissociating -- having had -- a laser beam -- a spectrum for the polarization direction compounded by the synthetic means and this synthetic means for making an optical axis again in agreement to dissociate for every polarization direction near the processing head, and use a mutually different laser beam for processing -- the laser-beam-machining equipment characterized by having a means.

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the laser-beam-machining approach and equipment, and relates to amelioration of the laser-beam-machining approach and equipment which supplied the laser beam outputted from one set of a suitable laser oscillator to use for the laser hole dawn machine into which a printed circuit board is processed especially to two or more processing heads.

[0002]

[Description of the Prior Art] In order to form the through hole and beer hall with a diameter of 0.1mm or less which were miniaturized with a miniaturization and advanced features of the latest printed-circuit board with a sufficient precision, the laser beam of a pulse oscillation mold is used and the laser hole dawn machine which forms the hole of a minor diameter is put in practical use.

[0003] In this laser hole dawn machine, generally, in order to raise working capacity, breaking a hole is simultaneously performed to the printed-circuit board with two or more

processing heads, in that case, a laser oscillator is communalized and a miniaturization and cost cut of equipment are achieved.

[0004] Carrying out energy division with splitter optics, such as a half mirror, a polarization mirror, and a beam splitter, and supplying conventionally, the laser beam outputted from one laser oscillator to two or more processing heads is performed in that case.

[0005] However, by this approach, in order to divide energy, as shown in drawing 1, in after the peaking capacity P0 of the laser beam before division dividing, it decreased (in 2 division, halved in P1 and P2), and had the trouble that the energy ratio when productivity not only falling, but dividing was also uncontrollable to accuracy.

[0006] In order to solve such a trouble to JP,2000-263271,A As shown in drawing 2, the laser beam 12 outputted from one set of the laser oscillator 10 Processing head 30A, Carrying out time sharing with the number of 30B (drawing two sets) and the same number \*\*\*\*\* beam distribution plastic surgery equipments 16A and 16B, supplying the laser beams 20A and 20B of the shape of this pulse which carried out time sharing to the processing heads 30A and 30B, respectively, and using them for processing of a workpiece 8 is proposed.

[0007] In drawing, the zero-order light in which 18A and 18B passed the beam distribution plastic surgery equipments 16A and 16B, respectively, and 22 The beam dump for absorbing zero-order light 18B, and 32A and 32B The 1st galvanomirror for scanning in the 1st respectively level direction, and 34A and 34B the primary light 18A and 18B by which time sharing was carried out with said beam distribution plastic surgery equipments 16A and 16B The 2nd galvanomirror for scanning the beam scanned in the 1st level direction with this 1st galvanomirror 32A and 32B in said 1st direction and the 2nd level direction which intersects perpendicularly, 36A and 36B are ftheta lenses for condensing the laser beam horizontally scanned with said 1st and 2nd galvanomirrors 32A, 32B, 34A, and 34B, and hitting against a workpiece 8 as processing beams 38A and 38B.

[0008]

[Problem(s) to be Solved by the Invention] however, by the approach proposed by JP,2000-263271,A Although a graphic display is omitted in drawing 2 in order that one means 16A and 16B for carrying out time sharing of the beam is not only required for every divided beam, but the laser beam after time sharing was carried out with the beam distribution plastic surgery equipments 16A and 16B may follow the path which became independent, respectively The mask for specifying the beam expander for expanding a laser beam, and the configuration of a processing point, Before carrying out incidence to said galvanomirror, it not only enlarges, but it is necessary to also prepare optics, such as a collimator lens for making a beam parallel-ray-ize, or a field lens, for every beam, and cost becomes high. Moreover, it had troubles, like there are many amounts of zero-order light 18B by which time sharing was not carried out with the beam distribution plastic surgery equipments 16A and 16B, and there is much futility of energy.

[0009] This invention is [0010] which makes it a technical problem to have been made in order to cancel said conventional trouble, and to improve productivity with few optics.

[Means for Solving the Problem] In the laser-beam-machining approach which supplied the laser beam outputted from one set of a laser oscillator to two or more processing heads, this invention carries out time sharing of said laser beam, and as it returns on the

same optical axis and it dissociates for every polarization direction near the processing head, after differing mutually, and it uses the polarization direction of this laser beam by which time sharing was carried out for processing, it solves said technical problem.

[0011] In the laser-beam-machining equipment with which this invention supplied the laser beam outputted from one set of a laser oscillator to two or more processing heads again The polarization direction of the laser beam by which time sharing was carried out with the time-sharing means and this time-sharing means for carrying out time sharing of said laser beam by the appearance side of the polarization means for differing mutually, and this polarization means The laser beam from which the polarization direction compounded by the synthetic means and this synthetic means for making again in agreement the optical axis of the laser beam by which time sharing was carried out differs mutually is separated for every polarization direction near the processing head. the spectrum for using it for processing -- similarly by having a means, said technical problem is solved.

[0012]

[Embodiment of the Invention] With reference to a drawing, the operation gestalt of this invention is explained to a detail below.

[0013] The sound modulation element 40 for carrying out time sharing of the laser beam 12 of the linearly polarized light (for example, P polarization) outputted from the laser oscillator 10, as this operation gestalt is shown in drawing 3 (AOM), The 90 degrees of the polarization directions with the same polarization direction as this zero-order light 42 in which time sharing was carried out by AOM40 of the primary light 44 are rotated. The 1/2-wave ( $\lambda$ ) polarizing plate 46 for changing into S polarization which is different in the zero-order light 42, The reflective mirror 48 and spectroscope 50 (polarizer) for turning up the primary light changed into S polarization with this 1/2-wave polarizing plate 46, returning on the again same optical axis as the zero-order light 42, and compounding, The beam expander 54 for expanding the composite beam 50 including both P polarization compounded by this polarizer 50, and S polarization, The mask 56 for carrying out the mask of the beam expanded by this beam expander 54, operating orthopedically, and specifying the configuration of a processing point, The collimate lens 60 for parallel-ray-izing the plastic surgery beam 58 which passed this mask 56, The spectroscope 64 for taking out P polarization component, for example and supplying 1st processing head 30A from the collimated beam 62 which passed this collimate lens 60, (polarizer), It has the reflective mirror 66 for reflecting S polarization component which passed this spectroscope 64, and supplying 2nd processing head 30B.

[0014] Said AOM40 starts the pulse of a laser beam by turning force current on and off on a predetermined frequency using the principle which changes the angle of refraction of a diffraction grating.

[0015] In drawing, 31A and 31B adjust whenever [ angle-of-reflection / of the processing beam drawn by said polarizer 64 and the reflective mirror 66 ]. The reflective mirror for reflecting in the direction of said 1st galvanomirror 32A and 32B, and 39A and 39B The beam dump prepared in each processing heads 30A and 30B for absorbing the processing beams 38A and 38B at the time of non-processed and 70 are a controller which performs control which switches said AOM40 to predetermined timing while giving a trigger to said laser oscillator 10.

[0016] Since it is the same as that of the conventional example shown in drawing 2 about



other points, explanation is omitted.

[0017] The example of each part signal wave form in this operation gestalt is shown in drawing 4 . From said controller 70, while giving a trigger signal as shown in drawing 4 (A) to the laser oscillator 10, the switch signal of zero-order light and primary light as shown in (B) is given to said AOM40.

[0018] First, processing actuation is performed to the first timing T1 of turning on a laser trigger by P polarization component which the zero-order light 42 is made to be passed AOM40, and is supplied to 1st processing head 30A through a polarizer 50, the beam expander 54, a mask 56, a collimator 60, and a polarizer 64. At this time, the beam which leaks to the 2nd processing head 30B side reaches beam dump 39B prepared in this 2nd processing head 30B, is made by operation of the 1st and 2nd galvanomirror 32A and 32B, and is absorbed.

[0019] Next, to the timing T2 from which a laser trigger serves as ON, in AOM40, S polarization component which the primary light 44 was made to be passed by reverse, and was reflected in it by the reflective mirror 66 through the 1/2-wave polarizing plate 46, the reflective mirror 48, a polarizer 50, the beam expander 54, the mask 56, the collimator lens 60, and the polarizer 64 is supplied to 2nd processing head 30B, and processing actuation is performed by this 2nd processing head 30B. At this time, the beam which leaks to the 1st processing head 30A side reaches beam dump 39A prepared in this 1st processing head 30A, is made by operation of the 1st and 2nd galvanomirror 32A and 34A, and is absorbed.

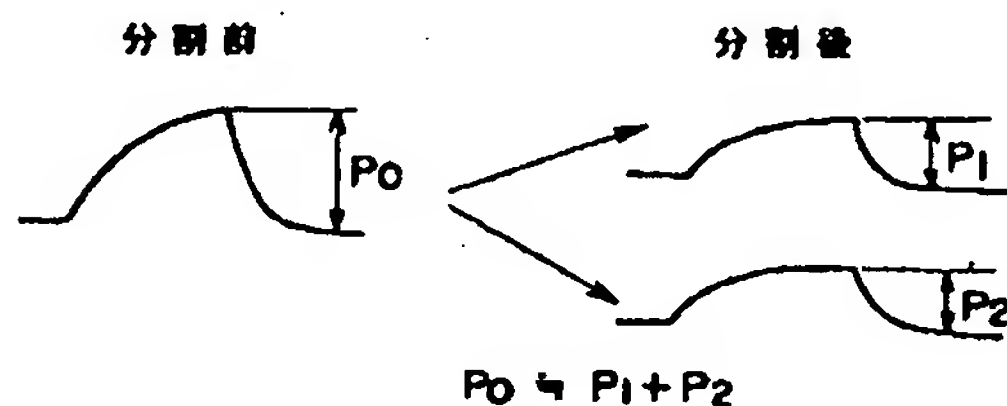
[0020] Thus, while reducing the number of the required beam time-sharing components for every processing head conventionally by changing the polarization direction for AOM40 with a switch and the 1/2-wave polarizing plate 46 for every pulse -izing of the optics, such as the beam expander 54 which needed to be made to become independent for every processing head, a mask 56, a collimate lens 60, and a field lens, can be carried out [ \*\*\*\* ], and economization and a cost cut of an installation tooth space can be aimed at compared with the case where optical system is independently established for every processing head.

[0021] In addition, in said operation gestalt, although AOM was used as a time-sharing means, a time-sharing means is not limited to this. The application symmetry is not limited to a hole dawn machine, either.

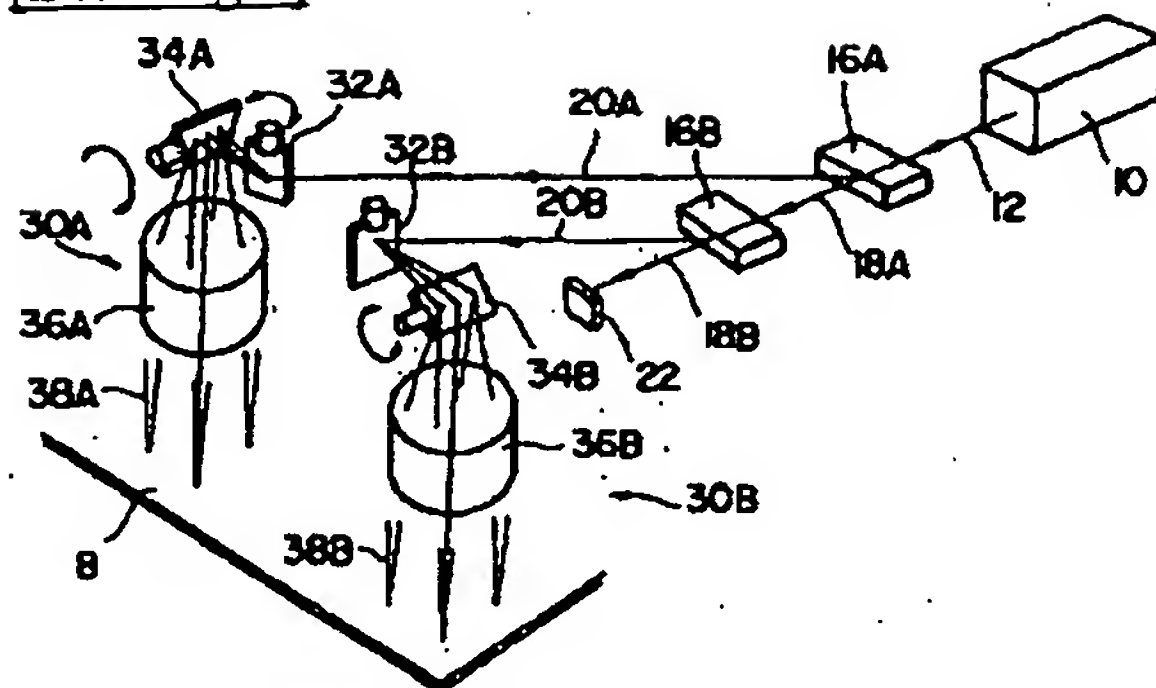
[0022]

[Effect of the Invention] A cost cut can be aimed at, while according to this invention becoming possible to share some optics for beams divided into each processing heads while reducing the number of the required beam time-sharing components for every processing head and planning space-saving.

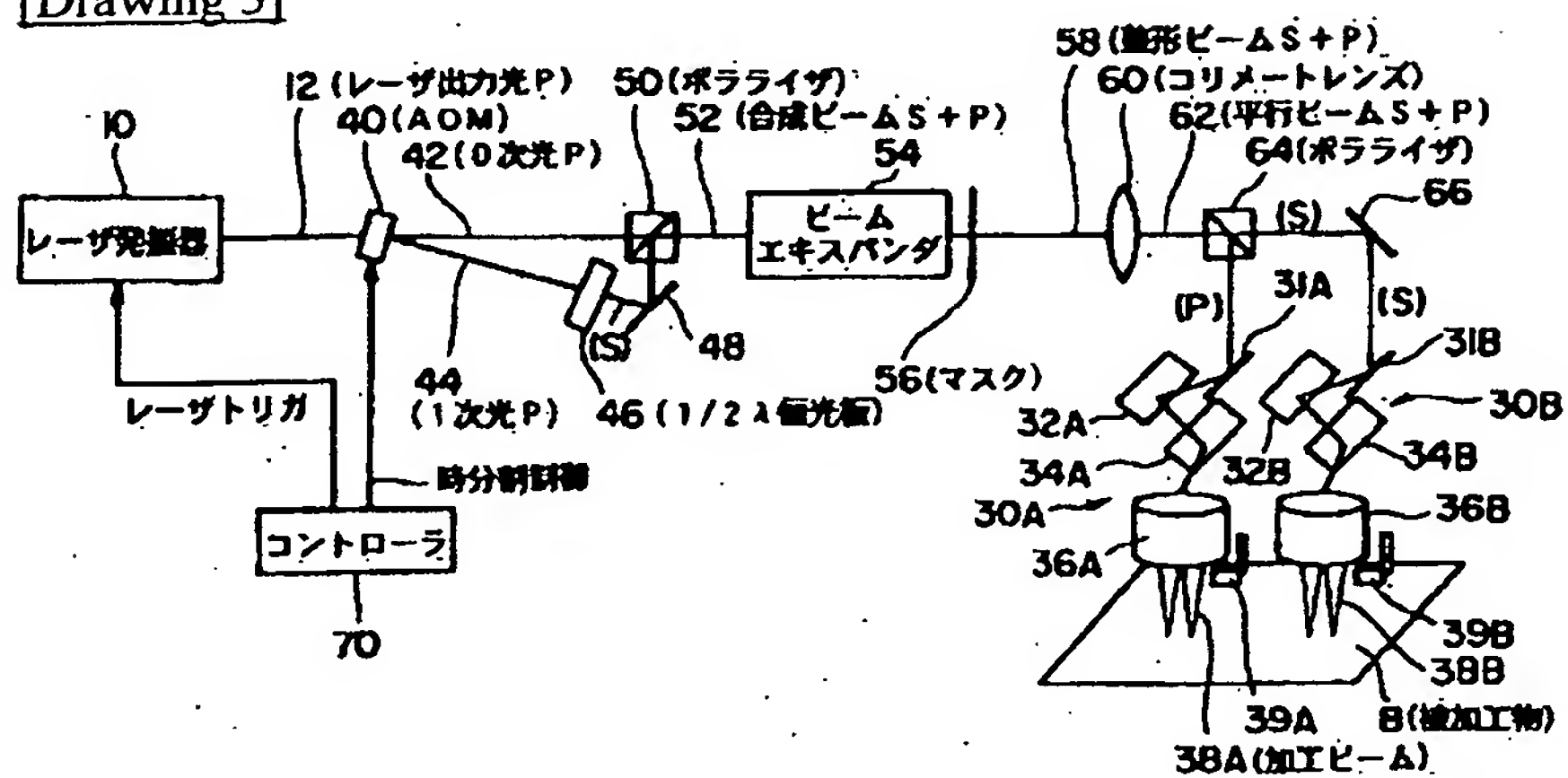
#### [Drawing 1]



[Drawing 2]



[Drawing 3]



[Drawing 4]

